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The gastroepiploic artery as a coronary bypass graft

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SUMMARY AND CONCLUSIONS

This thesis evaluates the use of the right gastroepiploic artery (GEA) as a coronary bypass graft. The use of the GEA for revascularization of the ischemic myocardium is not new. In the early sixties Bailey¹ used the GEA as an intramyocardial implant like the internal mammary artery (IMA) in the Vineberg procedure². Later, after the development of coronary angiography and by using the heart-lung machine the surgical technique has changed and it has become possible to perform direct anastomoses between the aorta and the stenosed coronary vessels. The saphenous vein has been for several years the graft of choice in routine coronary bypass operations because the vein is easy to harvest and is available in nearly every patient. However, the long-term results of the vein grafts are disappointing compared to the very good long-term results with IMA-grafts. Patients operated with the use of at least one IMA-graft have an improved survival and a reduction of late cardiac events³ when compared to patients with vein grafts only. However, in patients with three-vessel disease, even the combined use of both IMAs do not always provide enough graft material to revascularize the entire myocardium. In particular the inferior wall of the heart is almost always inaccessible for the IMA-grafts.

Why do we use of the GEA as a bypass graft? In the late eighties the first reports were published about the use of the GEA as a good alternative graft for direct revascularization of the inferior wall of the heart. What are the main advantages for its use? One of the main advantages is that we can use the GEA as a pedicled arterial graft. Another advantage is that the diameter is comparable to the target coronary arteries. Finally, the stomach and therefore the GEA are very close to the heart and they are only separated by the diaphragm.

The GEA is in most patients an excellent alternative for vein grafts due to the disappointing long-term results of vein grafts, especially in young patients. Combining the GEA and one or two IMAs it is possible to perform bypass operations without the use of vein grafts. Our opinion is to give the patients the best operation at the first time with arterial grafts, instead of sparing the arterial grafts for the redo-operation. According to this concept, we have used the GEA as a coronary bypass graft in more than 800 patients from September 1989 until today.

Chapter 1 is a general introduction of the thesis.

In **chapter 2-1** we describe the similarity and differences in pharmacological response between GEA and IMA. The endothelial function of GEA and IMA shows similar responses to vasoactive drugs. The difference in anatomy of the media causes the main difference in response. The GEA is a muscular artery, with only muscle fibres in the media, compared to elastic fibres in the media wall of the IMA. Vasoactive drugs give therefore in the GEA a more pronounced reaction than in the IMA. In **chapter 2-2** we investigate the pharmacological reaction of sumatriptan (5-hydroxytryptamine agonist) on GEA and IMA rings. In both GEA and IMA, sumatriptan gives an additional contraction after a previous gift of phenylephrine. We performed the experiment after the publication of a report about a young woman who suffered from a myocardial infarction due to coronary spasm after treatment with sumatriptan for migraine.

In **chapter 3** we describe the patients who underwent a coronary bypass operation with the use of the GEA. In **chapter 3-1** we describe the results of the first 300 patients who underwent complete arterial grafting with the use of the GEA. The indication for operation in these patients was one-, two-, or three-vessel disease. The patency of the GEA increased after a learning curve to nearly the same values as for IMA-grafts. In **chapter 3-2** we describe a subgroup of 256 patients who underwent an operation for three-vessel disease with the use of three arterial grafts: the GEA and both IMAs. The mid-term results in this group of patients were excellent, with low morbidity and mortality, even in elderly patients. The patency of the GEA was not as high as we expected because mainly only patients with complaints underwent re-angiography. In **chapter 3-3** we describe the long-term follow-up (7 years) of the same group of patients as in chapter 3-2. The concomitant use of the GEA and both IMAs results in a low mortality, a high freedom from myocardial infarctions and a high freedom from reinterventions at 7-years after the operation. The most promising outcome is the high freedom from angina pectoris (85.4%).

In **chapter 4** we describe the use of the GEA as a coronary bypass graft in patients who underwent a redo-operation. During the first operation the patients had a LIMA-graft to the left anterior descending artery and in most patients also a vein graft. The LIMA was patent in all patients and vein graft disease was in most of them the reason for recurrence of angina. A reoperation with the use of the GEA by a small laparotomy is for them a 'simple' solution for the problem, which not put in danger the patent graft to the LAD.

In **chapter 5** we describe two complications related to the use of the GEA. Excessive coagulation on branches of the gastric wall caused probably the gastric perforation. After several laparotomies for treatment of a fungal peritonitis, the patient survived and is nowadays in a good condition without angina. The second case is a patient who suffered from severe dyspnoe caused by a pneumopericardium and pneumoperitoneum. There was pendulant gas between the pericardial and peritoneal cavities. The cause of the gas formation remained unclear, but when the gas disappeared, the patient recovered well.

LIMITATIONS OF THE STUDY

This thesis evaluates the use of the GEA as a coronary bypass graft in combination with the internal mammary arteries. The limitation of this thesis is that we have not compared the use of the GEA with the use of the vein graft, today's standard graft for revascularization of the inferior wall of the heart. Only a prospective randomised study with a long-term follow-up can give the answer what is better for revascularization of the branches of the inferior wall of the heart. Years ago we tried to find grants for financing a well designed prospective randomised studies in which we want to compare the use of the GEA and vein graft to the same region of the heart, but these studies were not granted. To start such a study today is much more difficult because at the moment there is a solid body of information

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about the better long-term results of arterial grafts. In my opinion there is hardly any need for the use of vein grafts anymore. Short-term results will probably be the same, but without "vein graft disease" patients will do better after years with only arterial grafts. This philosophy, that arteries are better than veins used as coronary bypass grafts, resulted in a personal operation score for 1996 with at least one artery in 100% of the patients and total arterial revascularization in more than 90% of the patients.

CONCLUSIONS

The results of the studies reported in the thesis demonstrate that the GEA is a reliable and effective arterial conduit for coronary artery bypass surgery. The use of the GEA as an arterial conduit is a second choice with respect to the IMAs, but with potential benefits and long term results superior to any non-IMA conduit ever known. The results of clinical and angiographic follow-up show that the GEA has a better patency and therefore a higher freedom from cardiac related events than any other non-IMA conduit [see Chapter 3]. In addition, ultrastructural, physiologic and pharmacological studies [see Chapter 2] have shown that the GEA exhibits some interesting similarities to the morphology and physiology of the IMA. The clinical and angiographic results of the IMAs remain of course the "gold standard" in coronary surgery. However, even the extended use of bilateral IMAs and sequential anastomoses do not permit a complete arterial revascularization in the majority of patients. The coronary arteries of the inferior wall of the heart, namely the right posterior descending artery, are in the majority of the patients inaccessible for the IMAs. Therefore the GEA appears today as the ideal conduit for the revascularization of the inferior wall of the heart, in view of a complete arterial myocardial revascularization. A meta-analysis comparing our current experience (unpublished data) [Table I] to the largest published series of complete arterial revascularization using the IMAs and the GEA in patients undergoing elective primary CABG, shows that both early clinical and angiographic results of the GEA are satisfactory and promising.

	Pt.	Death	PMI	LCO	Bleeding	MWC	CVA	FW-UP	Patency
<i>Grandjean</i> ⁴	638	1.4	1.4	1.9	5.2	0.5	0.8	24 months	90%
<i>Suma</i> ⁵	400	2	1.5	4.7	-	-	-	2 months	95%
<i>Manapar</i> ⁶	152	4	5	3	4	7	1	1 month	80%
<i>Jegaden</i> ⁷	240	0.4	1.6	0.8	0.8	1.2	0.4	1 month	96%

Table I. Meta-analysis.

Pt.: total number of patients; Death: in-hospital mortality; PMI: perioperative myocardial infarction; LCO: low cardiac output; Bleeding: reoperation for bleeding; MWC: major wound complications; CVA: cerebro-vascular accidents; FW-UP: angiographic follow-up; Patency: patency of the GEA at follow-up. Data in percentage.

In addition, our clinical experience shows that the occurrence of early complications [see Chapter 5] with the use of the GEA was due to the learning curve. After some years of worldwide use of the GEA and with the current standardization of the surgical technique we expect that such troubles will disappear from future clinical reports.

In conclusion, being a complete arterial revascularization the first determinant of a better life-expectancy and life-quality for patients with coronary artery disease and being a reduction of redo-operations in coronary surgery one of the target of any health care system, we strongly believe that the GEA can play a main role in the future of coronary surgery. The technical difficulty and the increased time consumption required to perform a complete arterial revascularization using both IMAs and the GEA will be counterbalanced by a consistent improvement in patients' life and in the use of health care resources.

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V-UP Patency

months	90%
months	95%
month	80%
month	96%

arction, LCO: low
: cerebro-vascular
in percentage.